Trace Metal cycling in the SE-Atlantic and Benguela Upwelling System

First results from GEOTRACES cruise GA08

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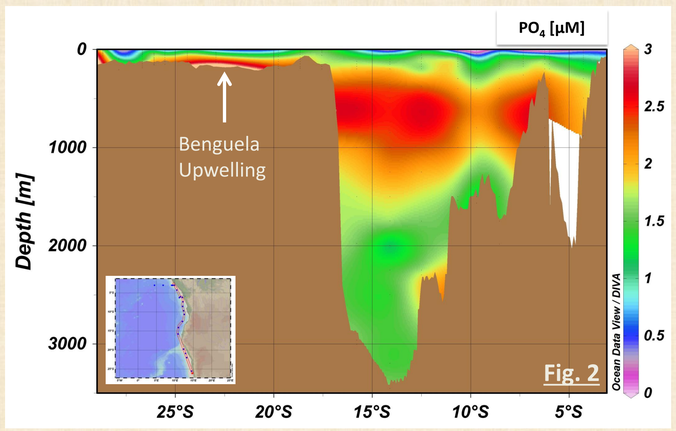
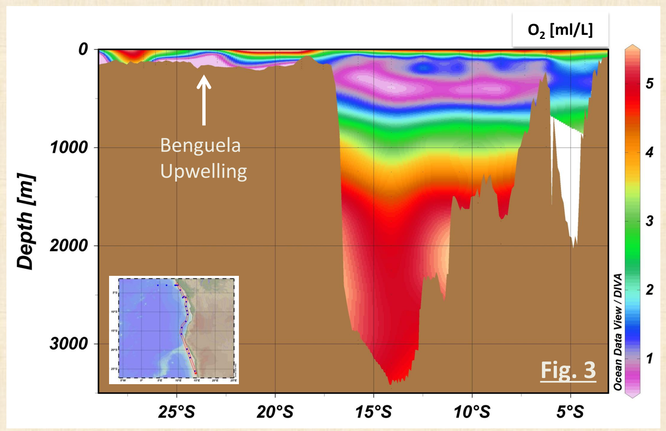
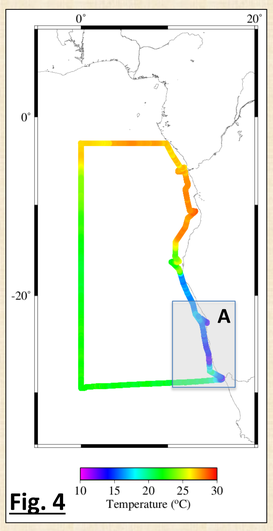
The Study Region

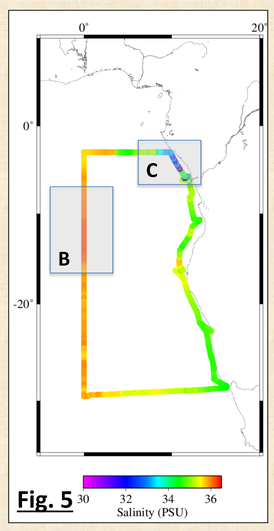
- GEOTRACES cruise M121 focused on the biogeochemical cycling of trace elements in the SE-Atlantic, a region with a strong oxygen minimum zone (OMZ) and trace metal supply from sedimentary, riverine, and aeolian sources.
- Special emphasis was put towards characterisation of TM fluxes within the **Benguela Upwelling Region**, its corresponding **OMZ** and **Congo River inputs**.





↑**Fig 2&3**: Phosphate (µMol/L) and Oxygen (mL/L) along the Shelf transect, indicating the OMZ, the Benguela Upwelling and subsequent large scale Primary Production over vast majority of the Namibian Shelf.[5] Oxygen drops to non-detectable concentrations around **23°S**. PO_4 as proxy for remineralisation mimics O_2 consumption to slightly higher depths.



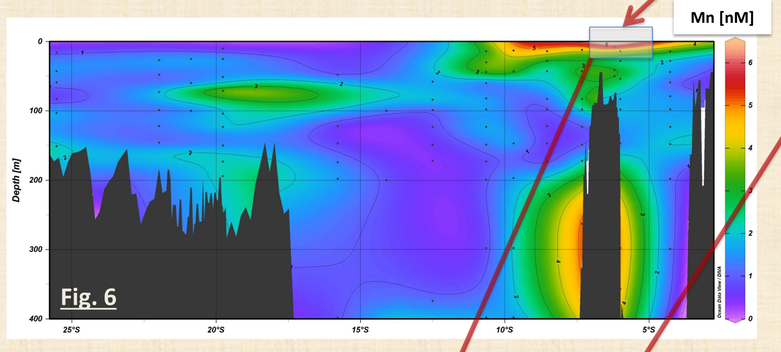


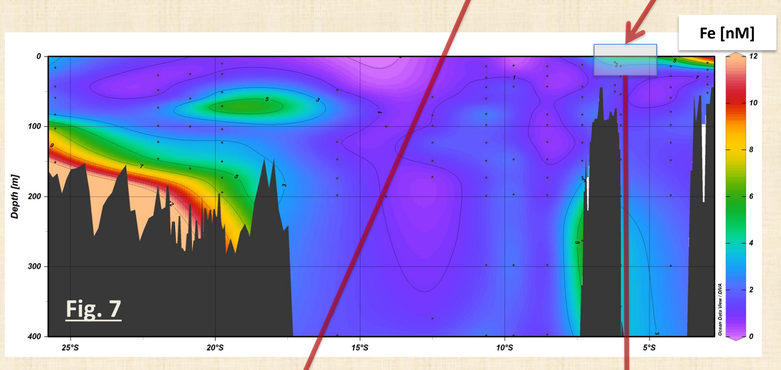
↑**Fig 4 & 5**: Sea Surface Salinity (SSS) und Sea Surface Temperature (SST) indicative of strong regional differences along the sections. Lüderitz Cell (**A**), South Atlantic Gyre (**B**) and Congo River Plume (**C**).

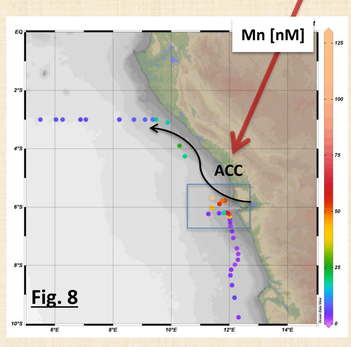
→ **Fig 6 & 7**: Mn & Fe section plots. Evident is the large sedimentary release of Fe in shelf bottom waters to concentrations of 12 nM/L. Low oxygen levels (**fig. 3**) aid the reductive dissolution of Fe. High surface Mn results from Congo river inflow (**6°S**), held in surface layers by photo reduction and complexation.
Although a very high dissolved fraction in Fe is evident from the towed fish samples (5m depth, **fig. 8 & 9**), DFe is barely visible in the shelf water section below 10m.

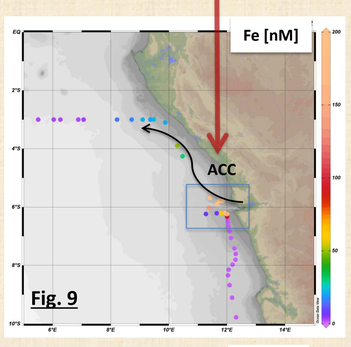
→ **Fig 8 & 9**: DFe and DMn concentrations in surface waters, collected by the towed fish (5m), and transported offshore within the Angola Coastal Current (**ACC**). Highest concentrations at the Congo River mouth (**DFe = 1.2 µM** and **DMn = 125 nM**]

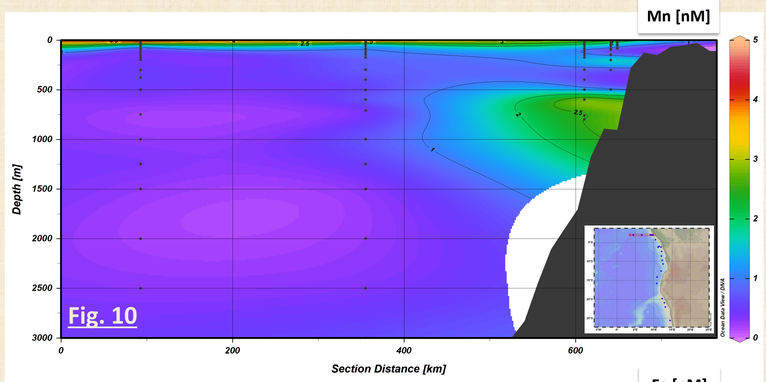
↓ **Fig 10 – 13:** Distribution of DFe, DMn, O_2 and PO_4 along the East-West transect following 3°S.

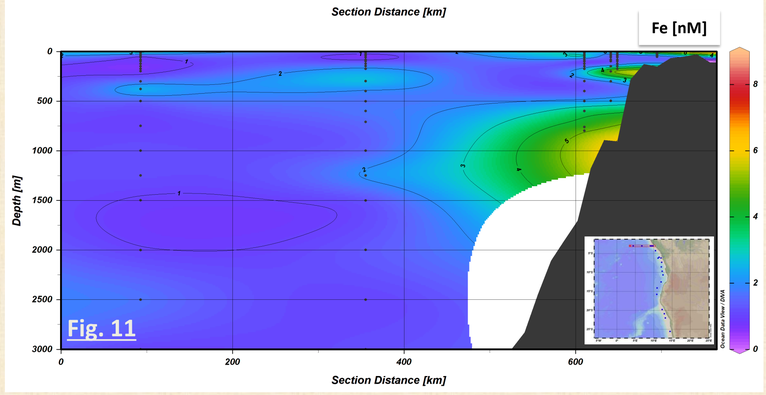


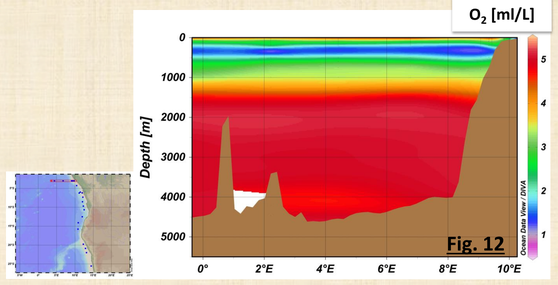


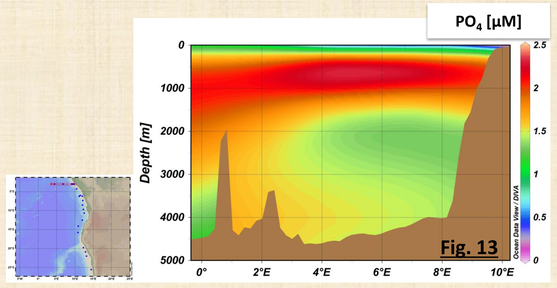












Expedition & Sampling

- RV Meteor cruise M121 (GEOTRACES GA08, **Nov-Dec 2015**)
- ultra-clean CTD rosette with 24x 12L GoFlo bottles
- Temperature, Pressure & Salinity-sensor @ CTD rosette
- **50 stations**, **740 partTM** (> 0.2 µm) **747 disTM** (0.2 µm), **314 solTM** (0.02 µm) samples
- **208 disTM towed fish**, **7 rainwater**, **16 aerosol** & **164 Radium** samples

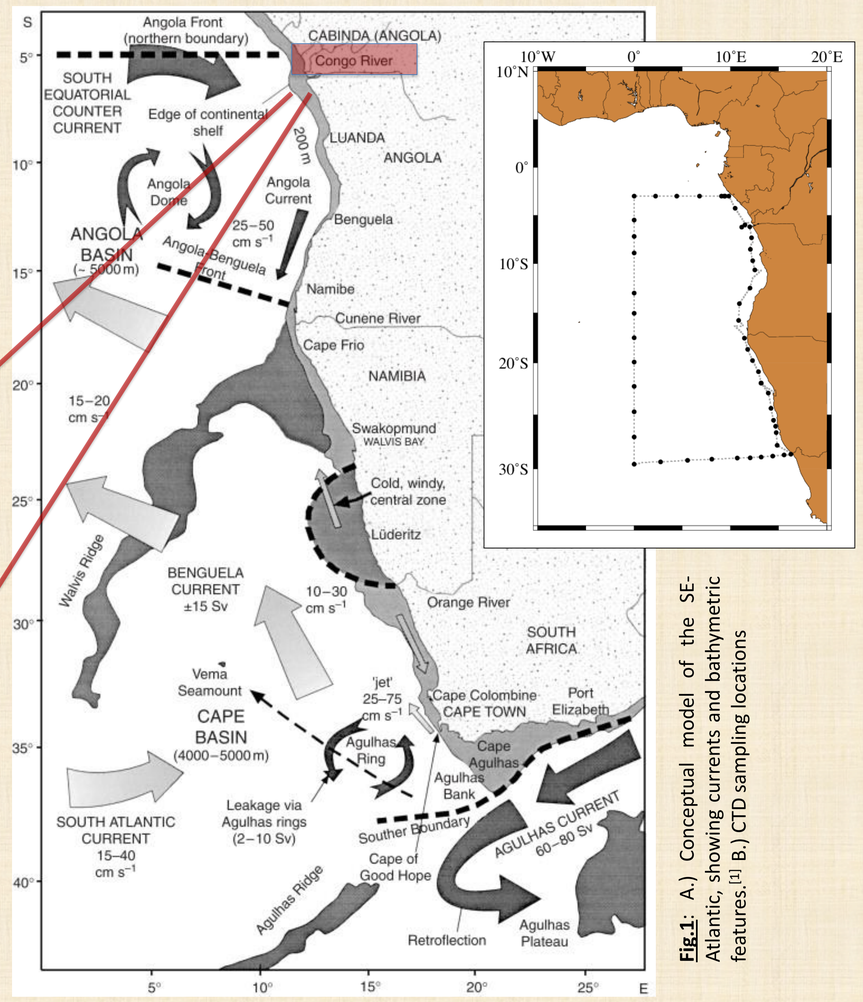


Fig.1: A.) Conceptual model of the SE-Atlantic, showing currents and bathymetric features.[1] B.) CTD sampling locations

Analytical overview

- TM-Analyses (Fe, Mn, Co, Cr, Cu, Zn, V, Mo, Ni, Cd, Pb) using Offline-SeaFAST preconcentration (WAKO-resin) and HR-SF-ICPMS.[2]
- Fe(II) & H_2O_2 measurements by Flow-Injection Analyses (FIA, on-board)
- Al determination by FIA following Lumogallion methodology.[3]
- ^{223}Ra, ^{224}Ra, ^{226}Ra & ^{228}Ra analyses via gamma-counting.[4]
- QuAAtro auto-analyser-system for PO_4, NO_2^-/NO_3^- & $Si(OH)_4$
- Completed stations: 22/50 (disTM); 52/52 (macronutrients).

Conclusion

- Strong sedimentary DFe source in the centre of the Benguela Upwelling.
- However, we mainly see offshore transport in the upper plume waters.
- The influence of the Congo plume towards the north of our transect is evident in the terrestrially derived DFe/DMn signal, but also dissolved Al[6] and Ra[7] over 1000 km offshore.

References

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